

THE FAIRY SHRIMP GENUS *BRANCHINELLA* SAYCE, 1903 (CRUSTACEA: ANOSTRACA: THAMNOCEPHALIDAE) IN SOUTH AUSTRALIA AND THE NORTHERN TERRITORY, INCLUDING DESCRIPTIONS OF THREE NEW SPECIES.

by BRIAN V. TIMMS<sup>1</sup> & MICHAEL C. GEDDES<sup>2</sup>

Summary

TIMMS, B.V. & GEDDES, M.C. (2003). The Fairy Shrimp genus *Branchinella* Sayce, 1903 (Crustacea: Anostraca: Thamnocephalidae) in South Australia and the Northern Territory, including descriptions of three new species. *Trans. R. Soc. S. Aust.* 127(1), 53–68, 31 May, 2003.

The genus *Branchinella* is represented by nine species in each of South Australia and the Northern Territory, 13 species in all and with just one species endemic in each. The most widespread and common species is *B. australiensis*, while *B. dubia*, *B. latzi*, *B. lyrtifera* and *B. pinnata* are locally common. Two of the new species (*B. insularis* n. sp. and *B. tyleri* n. sp.) occur in limited areas and the third (*B. lamellata* n. sp.) is a member of a group of arid-zone species. Despite a great increase in the number of species reported from both jurisdictions, large areas are still inadequately surveyed.

KEY WORDS: *Branchinella*, new species, biogeography, environmental ecology, gnamptas.

Introduction

Currently there are 26 described species of *Branchinella* in Australia (Geddes 1981; Belk & Brtek 1995; Timms 2001, In Press). Only three and six species respectively (total seven) have been reported from South Australia and the Northern Territory (Geddes 1981) and none are endemic. Possibly the reason for this lack of diversity is the paucity of collections (7 and 35 respectively) and the limited coverage of both regions. Over the last 20 years many more collections have become available (46 and 23 respectively), with many from previously unsampled areas. These collections contain three new species and many new records. The aim of this paper is to document this diversity, though many areas of both regions remain to be explored for anostracans.

Materials

Most of the additional collections are housed in the South Australian Museum (hereafter SAM) or in the personal collections of the authors. A few are stored in the Museum and Art Gallery of the Northern Territory (hereafter MAGNT), the Western Australian Museum (WAM) and the Australian Museum (AM) in Sydney. Many of these collections are from the general public, but significant samples from remote areas were provided by P. Aelfeldt & P. Cockerham (Gawler Ranges, SA), M.J. Tyler

(Victoria and Roper Rivers, NT; Andamooka, SA), P. De Deckker (Kangaroo Is, SA) and the senior author (Lake Eyre environs, SA). Collections mentioned in Geddes (1981) are listed under *Geddes 1981 SA* or *Geddes 1981 NT*, with details available in that publication. The additional material is listed under *New Material SA* or *New Material NT* and all relevant data given. Site locations of the collections previously mentioned in Geddes (1981) and of the new material are shown in FIG. 1. Synonymies include main entries only; full synonymies are given in Geddes (1981).

Taxonomy

Thamnocephalidae

*Branchinella* Sayce, 1903.

*Branchinella affinis* Linder

*B. affinis* Linder, 1941, pp 257–61, fig. 36; Geddes, 1981, pp 271–2, fig. 10.

Records

*New Material SA*: Dam 5 km south of Yarnea Homestead, Gawler Ranges, 32° 25' S, 135° 28' E, coll. P. Aelfeldt & P. Cockerham, 14-x-84, SAM C6050; pool east of Pandie Pandie, 26° 11' S, 139° 31' E, coll. BVE, 10-xii-00; Gidgee Ck near Neales R., 27° 58' S, 136° 04' E, P. Hudson, 2-iv-01; Birrabiana Waterhole, west of Lake Eyre, 28° 13' S, 135° 32' E, J. Pritchard, 2-xi-01. *New Material NT*: Eva Downs Station, 18° 00' S, 134° 52' E, coll. P. Latz, 18-iv-70; Napperby Station, 22° 54' S, 132° 38' E, coll. P. Latz, 21-v-70; Temporary swamp 67 km E of Docker R., 25° 04' S, 129° 40' E, J. Blyth, 1-vii-79; a rockhole on Uluru, 25° 21' S, 131° 03' E,

<sup>1</sup> School of Environmental and Life Sciences, University of Newcastle, Callaghan, NSW, 2308, email: bghy@calinga.newcastle.edu.au

<sup>2</sup> Department of Environmental Biology, University of Adelaide, Adelaide, SA, 5005, email: mike.geddes@adelaide.edu.au

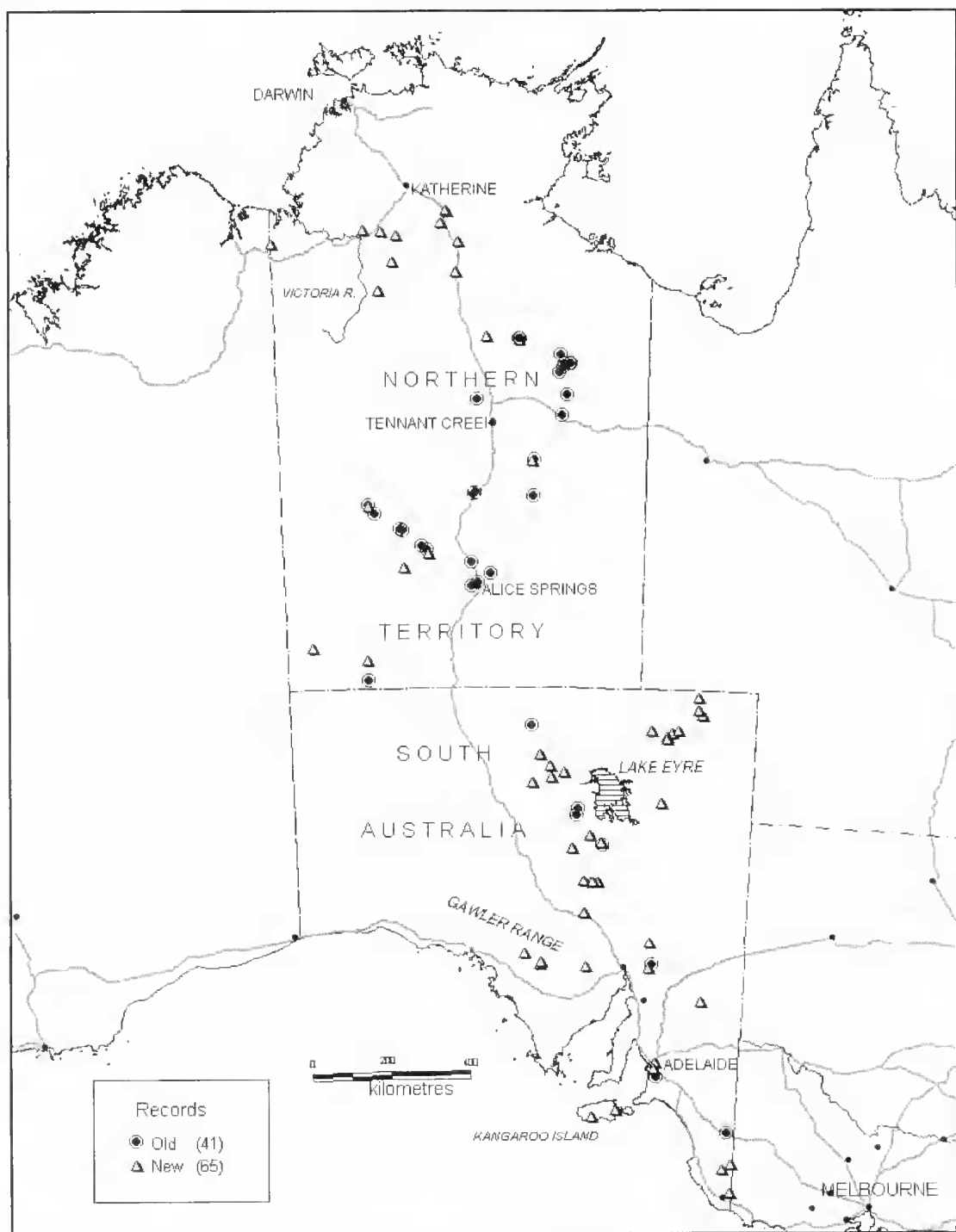


Fig. 1. Map of South Australia and the Northern Territory showing distribution of localities cited by Geddes 1981 and the new localities cited in the text.

coll. J. Blyth, 6-vii-79; same site, coll. R. Horner & I. Archibald, 23-i-83; same site, coll. D. Carter, 4-vii-91, same site coll. T. Annable, 10-vii-01.

#### Comments

Some of the present material exhibited significant differences from the recorded range of variability for the species (Geddes 1981). All the specimens from Docker R. and Napperby Station in the NT lacked the medial swellings on the proximal segment of the second antennae. The same specimens also had only a few small lateral protrusions on the pseudo-segments of the frontal appendage. Otherwise they had the typical features of *B. affinis*.

These are the first records of this species in both SA and NT. It is widely distributed as it is elsewhere in Australia (Geddes 1981; Timms & Sanders In Press; Timms In Press), though in SA it seems to be absent from the far south and in the NT from the far north (FIG 2). It often occurs in turbid waters, but has also been found in the clear waters of pools on top of Uluru.

#### *Branchinella arborea* Geddes

*Branchinella arborea* Geddes, 1981, p. 285-8, fig. 17.

#### Records

*New Material SA*: Gidgee Ck near Neales R., 27° 58' S, 136° 048' E, P. Hudson, 2-iv-01.

*New Material NT*: Temporary swamp 67 km E of Docker R., 25° 04' S, 129° 40' E, J. Blyth, 1-vii-79.

#### Comments

Despite these records being up to 1700 km west of the present known distribution of nw NSW-sw Qld (Geddes 1981; Timms & Sanders In Press), all specimens agree with the description of the type material. This species is uncommon in SA and NT and these are the first records of it in both areas (FIG 3).

#### *Branchinella australiensis* (Richters)

*Branchipus australiensis* Richters, 1876, p. 43-4, pl. 3.

*Branchinella australiensis* (Richters), Sayce, 1903, pp. 234-9, pl. 30; Linder, 1941, pp. 256-7, fig. 35; Geddes, 1981, pp. 256-60, fig. 12.

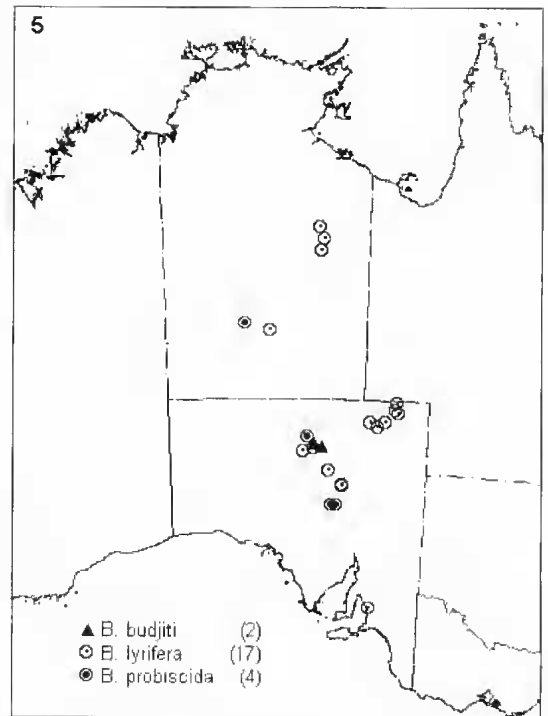
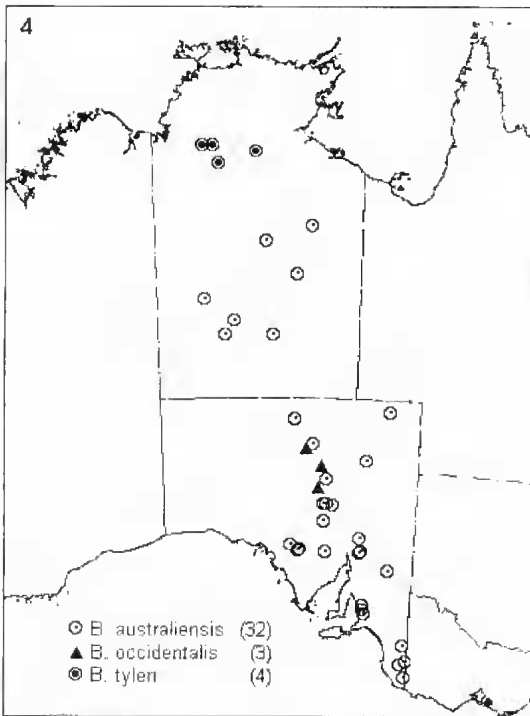
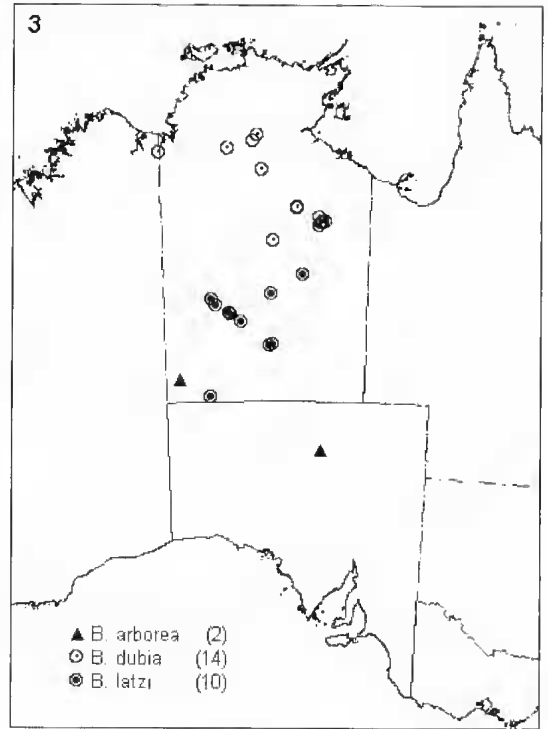
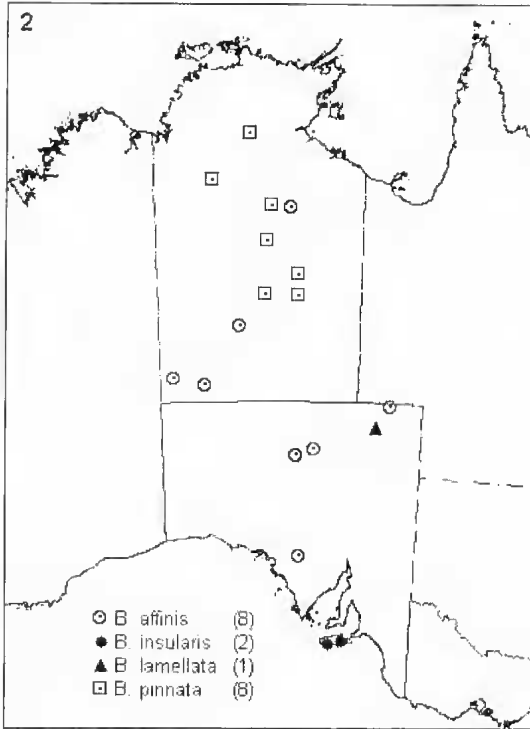
#### Records

*Geddes 1981 SA*: pool near Mt Sarah, 26° 55' S, 135° 15' E; farm dam near Carrieton, 32° 26' S, 138° 32' E; Upper Onkaranga Ck (i.e. Onkaparinga Ck?), ca 35° 05' S, 138° 45' E; Bordertown, 36° 18' S, 140° 46' E, WAM C12468. *Geddes 1981 NT*: dam, Brunette Downs, 18° 46' S, 135° 52' E; dam at Warrego Mine, Tennant Creek, 19° 23' S, 133° 53' E; pool near Hatches Ck Mine, 20° 48' S, 135° 16' E; Yalooaggarie Ck, Mt. Doreen Stn., 21° 49' S, 131° 10' E; Napperby Stn., 22° 45' S, 132° 29' E; cement

dam, Garden Stn., 23° 24' S, 134° 12' E. *New Material SA*: Cooper Ck, 28° 38' S, 138° 38' E, coll. Mrs Hiller, xii-1904, SAM C6046; pool, Elizabeth Downs, Adelaide, 34° 42' S, 138° 41' E, coll. Miss Poemann, 25-v-70, SAM C6043; pool, Holden Hill, Adelaide, 34° 51' S, 138° 40' E, coll. W. Weaver, 9-ix-71, SAM C6045; Eucola Ck, 17 km W Pimba, 31° 12' S, 136° 40' E, coll. A. Edwards, 2-x-75, SAM C6048; pool few km SW Bool Lagoon, 37° 07' S, 140° 41' E, coll. J. Glover, 24-x-78, SAM C6044; a samphire swamp, 8 km along track from Olympic Dam to Lake Blanche, 30° 29' S, 136° 48' E, 11-ii-81; flooded grassland 18.7 km along track Olympic Dam to Andamooka, 30° 27' S, 136° 39' E, 12-ii-81; cattle wallow 26.4 km along track Olympic Dam to Andamooka, 30° 29' S, 137° 02' E, 12-ii-81, all coll. M. J. Tyler; Swamp dam, Sturt Vale Station, 33° 14' S, 139° 53' E, coll. N. Edwards, 27-x-82; stonewall dam near Hiltapa Homestead, Gawler Ra., 32° 10' S, 135° 04' E, 14-x-84, SAM C6036; dam 5 km E of Yarnea Homestead, Gawler Ra., 32° 25' S, 135° 28' E, 14-x-84, SAM C6037; Woolshed Dam near Yarnea Homestead, Gawler Ra., 32° 23' S, 135° 31' E, 14-x-84, SAM C6039; dam at Yarnea Homestead, Gawler Ra., 32° 23' S, 135° 31' E, 15-x-84, SAM C6040; swamp 4 km E of Uho Homestead, Gawler Ra., 32° 39' S, 136° 43' E, 18-x-84, SAM C6038, all coll. P. Aelfeldt & P. Cockerham; Marshes Well Dam, Nonning Station, Gawler Ra., 32° 29' S, 138° 25' E, coll. T. Palsson, 12-x-85, SAM C6041; Lynwood Park, via Penola, 37° 40' S, 140° 57' E, coll. R.G. Beck, 6-x-89; Yelloch Ck., Carolside Stn., 37° 00' S, 140° 57' E, coll. V. Tsynibal and D. Schulze, 12-y-98; dam at Hawker, 31° 53' S, 138° 25' E, coll. N. de Pren, iii-00, SAM C6042; Birdsville Track near Bobbiemongie Turnoff, 26° 35' S, 139° 37' E, coll. BVT, 9-xii-00; Gidgee Ck near Neales R., 27° 58' S, 136° 04' E, coll. P. Hudson, 2-iv-01; claypan at Millers Ck, near Coward Springs, 29° 24' S, 136° 47' E, no coll., no date, SAM C6049. *New Material NT*: Mount Doreen, Central Australia, 21° 49' S, 131° 10' E, coll. unknown, 28-v-70, MAGNT Cr4867; Haast Bluff, 200 km W of Alice Springs, 23° 23' S, 132° 02' E, coll. P. Ellis, iv-87.

#### Comments

All of the new material examined lay within known variations for the species. It is by far the most common species in the collections of the South Australian Museum. This is probably because it is the largest fairy shrimp in the study area and hence more easily seen by the public, plus it lives in many habitat types. The 32 records of it in SA and NT are widely distributed (FIG 4), but there are none in the most northerly parts, a similar pattern to that in WA (Timms In Press).



Figs 2-5, Fig. 2. Distribution map of *B. affinis*, *B. insularis*, *B. lamellata* and *B. pinnata* in the study area. Fig. 3. Distribution map of *B. arborea*, *B. dubia* and *B. latzi* in the study area. Fig. 4. Distribution map of *B. australiensis*, *B. occidentalis* and *B. tyleri* in the study area. Fig. 5. Distribution map of *B. budjiti*, *B. lyrifera* and *B. proboscidea* in the study area.

***Branchinella budjiti* Timms**

*Branchinella budjiti* Timms, 2000, pp. 247-50, fig. 1.

**Records**

**New Material SA:** roadside pool ca. 70 km s Oodnadatta, 27° 50' S, 135° 44' E, coll. BVT, 29-xi-00; Gidgee Ck near Neales R., 27° 58' S, 136° 04' E, coll. P. Hudson, 2-iv-01.

**Comments**

Specimens in both collections are a little different from the material described from the Paroo (Timms 2001). The diagrams (FIG 6) are of specimens from Oodnadatta, though the same features were seen on the Neales material. On the second antennae (FIG 6A), the antennal appendage at the junction between proximal and distal segment is proportionally bigger than in Paroo specimens – it is about half of the length of distal segment, whereas in Paroo specimens it is about one third of the length. Differences in the two drawings are easily reconciled when it is realised the Oodnadatta specimen is viewed ventrally and the Paroo type material is drawn in dorsal view. The distal sclerotized segment of the second antenna in the Oodnadatta specimen is shaped differently to that in the Paroo specimens – there is hardly a medial bulge, and the 20° bend near the base is more medially placed in the Oodnadatta specimens.

The frontal appendage is also different (FIG 6C). In the Paroo material it is distinctly forked into two rectangular branches with angle between the two about 100°. In Oodnadatta specimens the two branches are not rectangular-shaped and are joined distally by an even concave surface. The much larger central area of the Oodnadatta form is completely devoid of ventral papillae compared to a central area in the Paroo specimens where papillae are less numerous. There is also little differentiation of ventral papillae in Oodnadatta form compared with a marked difference in size between those on the central rib and those on the lamella.

The final significant difference is on the mediodistal corner of the endopodite of the fifth thoracopod (FIG 6). In material from the Paroo there are about 10 setae with rounded knobs on one side basally (FIG 6D), but in the Oodnadatta specimens there are only ca. 4 such knobs, though they are longer (FIG 6B).

It is possible these Oodnadatta specimens represent a variety or subspecies of *B. budjiti*, but further specimens and study is needed before a decision can be made. They live in ponds/claypans northwest of Lake Eyre of similar high turbidity as the habitats *B. budjiti sensu strictus* occupies in the Paroo (Timms & Sanders in Press). This is the first record of this species outside the Paroo.

***Branchinella dubia* (Schwartz)**

*Podochirus dubius* Schwartz, 1917, pp. 7-8, fig. 5.  
*Branchinella dubia* (Schwartz), Smirnov, 1932, pp. 151-2; Linder, 1941, pp. 268-9; Gieddes, 1981, pp. 275-8, fig. 12.

**Records**

**Geddes 1981 NT:** Cherub Ck, Eva Downs Stn., 17° 59' S, 134° 55' E, MAGNT Cr4868; Homestead Dam, Eva Downs Stn., 18° 00' S, 134° 52' E, AM P19233; Corella Ck, Brunette Downs Stn., 18° 22' S, 135° 53' E; Dingo Waterhole, Brunette Downs Stn., 18° 33' S, 136° 08' E; Brunette Ck, 18° 33' S, 136° 07' E; Gidgee Ck, Brunette Downs Stn., 18° 34' S, 135° 58' E; Brunette Ck, 18° 39' S, 135° 57' E; dam, Brunette Downs Stn., 18° 46' S, 135° 51' E; dam at Warrego Mine, Tennant Creek, 19° 23' S, 133° 53' E; Milne R., Georgina Stn., 21° 33' S, 137° 07' E. **New Material NT:** pool 30 km S of the Victoria/Delamere Highway junction, 15° 33' S, 131° 39' E, 11-ii-83; pool by Roper R. Rd, 10 km e Stuart Highway, 15° 01' S, 133° 10' E, 13-ii-83; pool by Stuart Highway, 145 km s Katherine, 15° 16' S, 133° 01' E, 13-ii-83; pool by Stuart Highway, 21 km N of Day Waters turnoff, 16° 26' S, 133° 22' E, 13-ii-83; all coll. by M.J. Tyler; swamp, Keep R. Nat. Pk., 15° 41' S, 129° 02' E, coll. M.J. Tyler, M. Davies, G. Watson, 8-ii-86.

**Comments**

*B. dubia* is common in the north of the Northern Territory (FIG 3), as it is the in north of Western Australia (Timms in Press) and to a lesser extent in north Queensland (Gieddes 1981).

***Branchinella insularis* sp. nov.  
(FIG 7)****Type material**

Holotype: one male, length 13.5 mm, catalogue number C6028 SAM; Allotype one female, length unknown as last part of abdomen missing, C6029 SAM; Paratypes: 2 males, lengths unknown as last part of abdomen missing, C6030 SAM.

**Type locality**

A small lake north of Karatta Homestead, Kangaroo Island, SA, 35° 58' S, 136° 57' E, coll. P. De Dekker, 10-x-78.

**Other material**

Three males from a freshwater swamp just north of Salt Lagoon, Kangaroo Island, SA, 35° 50' S, 137° 38' E, coll. P. De Dekker, 9-x-78, C6031 SAM.

**Etymology**

The name refers to the fact both records for this species came from an island.

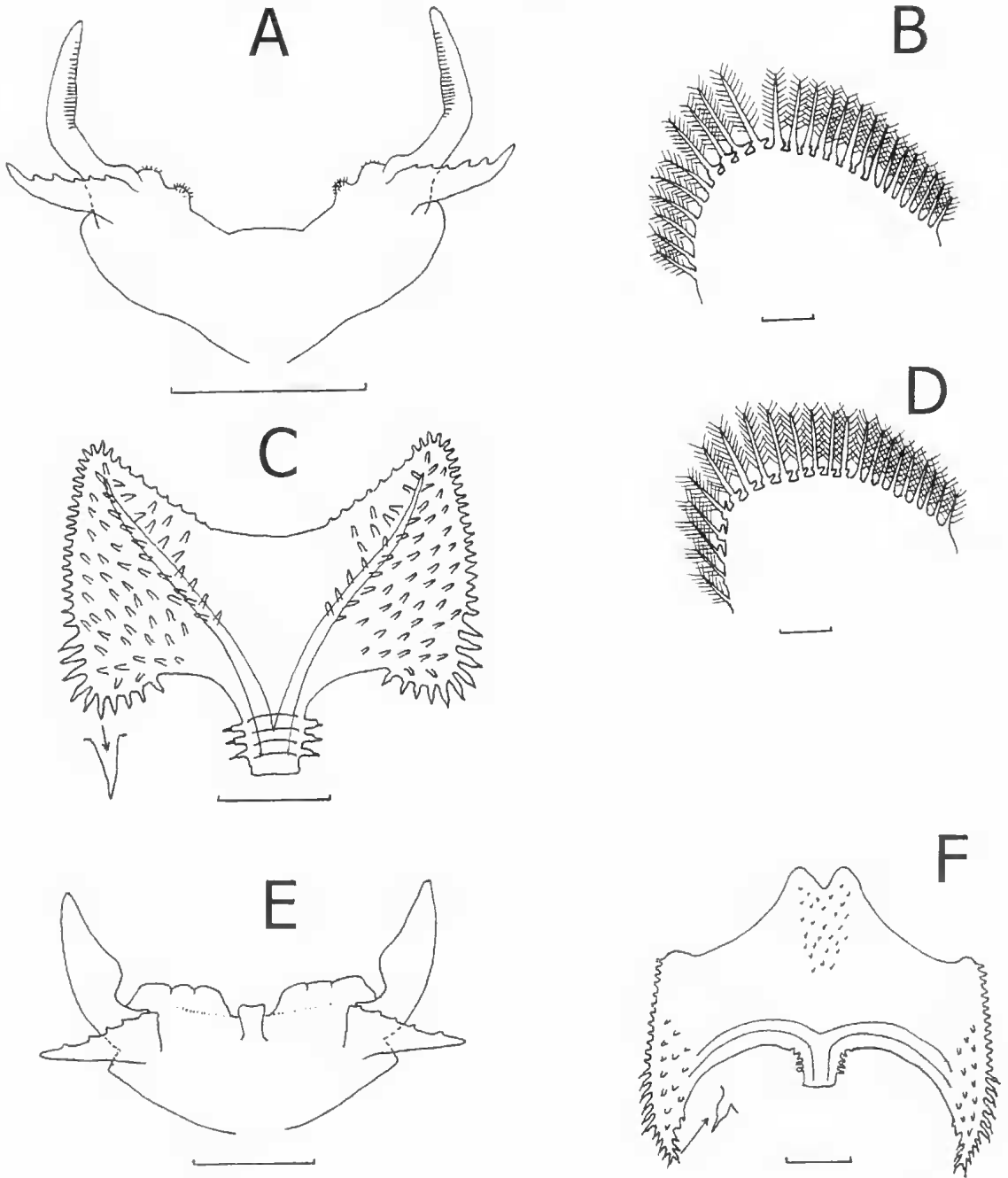


Fig. 6. Male *Branchinella budjiti* from Oodnadatta area. (a) Second antennae, (b) endopodite of 5th thoracopod, (c) frontal appendage, (d) male *B. budjiti* from claypan at Muella Station, nw of Bourke, endopodite of 5th thoracopod, (e) *B. lamellata* n. sp. from claypan at Bindegolly lakes, second antennae, (f) frontal appendage.

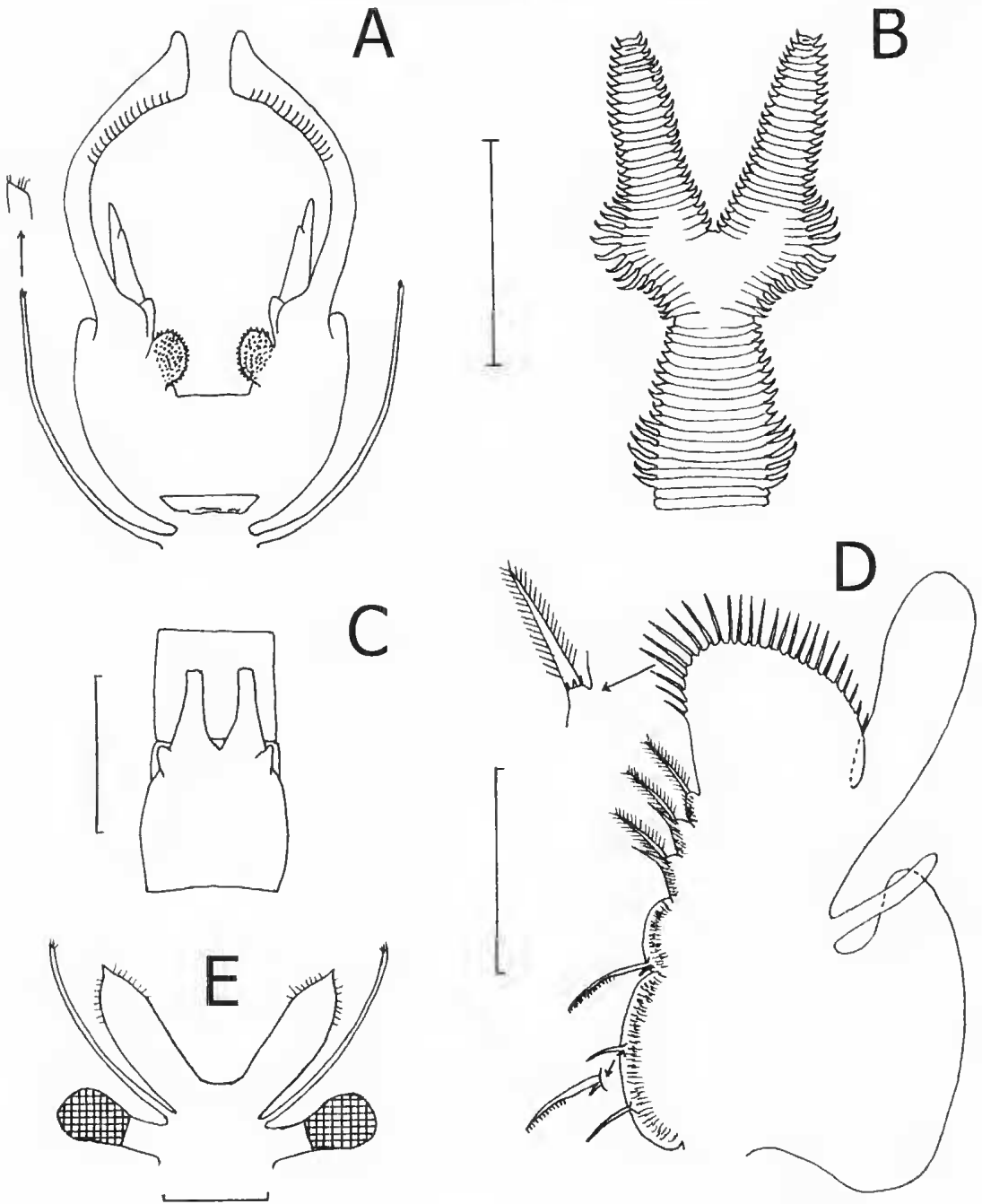


Fig. 7. *Branchinella insularis* n. sp. A-D male holotype, E female allotype. (a) first and second antennae. (b) frontal appendage. (c) rigid portion of penes. (d) 5th thoracopod without first anterior seta of endite 1 and posterior setae of all endites and exopodite. (e) head.



*Description of male*

First antennae (FIG 7A) slightly longer than proximal segment of second antennae; apex bearing two short hair-like setae apically and three longer hair-like setae subterminally. Second antennal (FIG 7A) proximal segments fused basolaterally, distal halves free and parallel to body axis. Distal free portions cylindrical, each with a medial large rounded protuberance bearing very small papillae. Proximal segment of second antenna bearing mediolaterally an antennal appendage in the same axis as distal segment of second antenna and ca 0.4 times the length of the distal segment. Apex of antennal appendage pointed and with a small papillae subapically. Distal segment arcuate both in dorsal (FIG 7A) and lateral view (not shown). Its medial surface rounded with a few weak transverse ridges on distal half; apex expanded to form a knob.

Frontal appendage (FIG 7B) about same length as second antennae, trunk wide with two simple branches, subequal in length. Most trunk and branch pseudosegments well defined, each pseudosegment with a lateral digitiform ventrally directed protrusion, terminating in a medially curved spine. Protrusions longest proximally on the trunk, and on the basolateral part of the branches. Basal area of each branch expanded laterally and nearly as wide as the base of the trunk, but narrowing apically and becoming symmetrical for much of its length. Apex of each branch blunt.

Rigid basal portion of penes (FIG 7C) largely fused and bulbous ventrally, with two separate tubular projections reaching (2/3rds) under the next postgenital segment. A small rounded lateral lobe on the posterolateral portion of the bulbous swelling of the basal portions. Structure of eversible portion of penes unknown.

Fifth thoracopod (FIG 7D) with both first and second endites large and evenly convex, endite 1 about 3 times larger than endite 2. Endites 3-5 small asymmetrical protuberances: submargin of all endites clothed in numerous minute hair-like setae. Anterior setae of endites 1 to 5 in formula 2,1,2,2,1 with distal anterior seta on each of endites 1 and 2 with a small subtending spine. One distal anterior seta each on endites 1 and 2 pectinate, and one distal anterior seta each on endites 3-5 plumose. Endites 3 and 4 with proximal anterior seta almost bare, and about half the length of the other seta. Posterior setae in formulae >45, ca 17-20, 3,2,2. Endopodite subquadrate, margins evenly rounded, bearing plumose setae that are smaller basally and longer on the distal margin. Plumose setae shorter than setae of the endites and exopodite and subtended basally by 2-3 spines. Exopodite elongate oval, three times longer than wide, bearing numerous marginal setae. Epipodite narrow, 5-6 times longer than wide,

cylindrical with a truncate apex. Praeepipodite large, two times longer than broad and with a large apical lobe; margin smooth, arcuate with greater convexity on apical lobe.

Telson with cercopods subequal to three abdominal segments; cercopods bearing plumose setae on both lateral and medial margins. Setae of uniform length, except those nearest the base a little shorter.

*Description of female*

Length unknown, but about the same as male.

First antennae (FIG 7E) slightly longer than second antennae. Similar hair-like setae as in male. Second antennae (FIG 7E) almost twice as long as length of eye plus eye stalk; leaf-like, 3-4 times longer than wide and apically acute. Many spines on outer distal margin.

Thoracopods as in male.

Brood pouch cylindrical, but length relative to abdomen unknown as later missing. Cysts relatively few (<20); surface of polygons with raised edges and sunken centres.

*Comments*

*B. insularis* is a member of Group II of Geddes (1981) (frontal appendage of a trunk and two simple branches, simple digitiform processes of the frontal appendage, lateral swelling to the base of the penes, and small to moderate size). Within the group it is most similar to *B. affinis*. The medial protuberance on the proximal segment of the second antennae is much more pronounced in *B. insularis* than in *B. affinis*; the apex of the distal segment of the second antennae is more expanded in *B. insularis*, and the frontal appendage has longer digitiform processes, especially near the base of the trunk and on the basolateral expansion of the branches. *B. insularis* has an antennal appendage at the distomedial corner of the proximal segment, which is absent in *B. affinis*, but is present in *B. denticulata* also of this group. It is of simpler construction in *B. insularis* — a simple tapering rod with a weak papillae subapically, compared to a triangular lamella serrated by many papillae on its distal surface. *B. insularis* lacks the characteristic array of small outgrowths on the medial surface of the proximal segment of the second antenna in *B. denticulata*.

In Geddes' (1981) key to Australian species of *Branchinella*, *B. insularis* straddles couplet 9 so this has to be reconstituted:

9. Proximal segment of male second antennae with an outgrowth from the distal end ..... 9a
- - - Proximal segment of male second antennae without such outgrowths ..... 10
- 9a. Male frontal appendage with longer digitiform processes near base of trunk and also



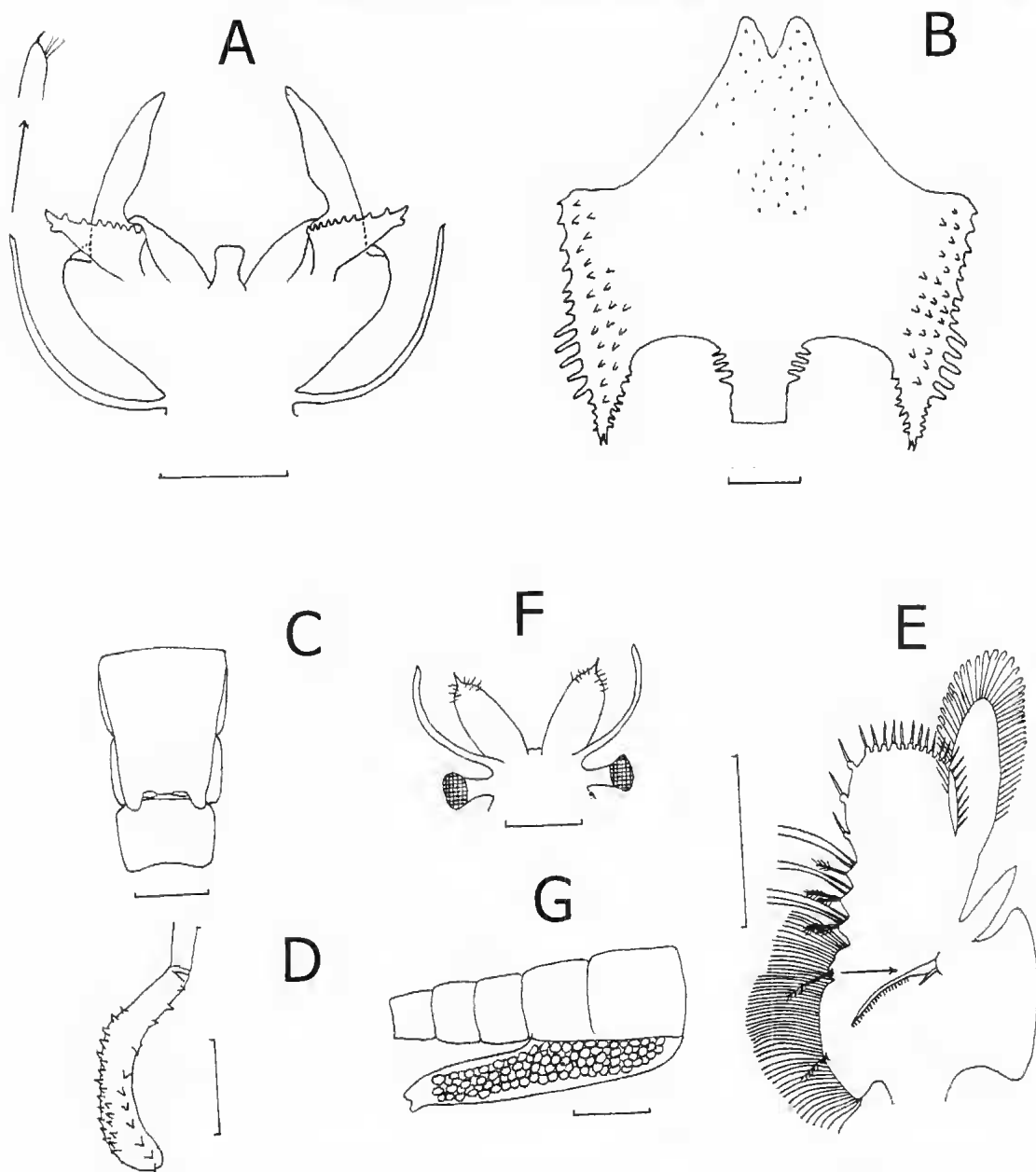


Fig. 8. *Branchinella lamellata* n. sp male holotype, F-G female allotype. (a) first and second antennae. (b) frontal appendage without first anterior seta of endite 1 and posterior setae of all endites and exopodite. (c) rigid portion of penes. (d) penes (e) fifth thoracopod (f) head. (g) brood pouch.

laterobasally on the two branches .....*B. insularis*  
 – Male frontal appendage with digitiform  
 processes of equal length or absent.....12

*B. insularis* has been found only on Kangaroo  
 Island, southwest of Adelaide (FIG 2).

***Branchinella lamellata* sp. nov.**  
 (FIG 8)

*Type material*

Holotype; one male, length 17.2 mm, C6032 SAM;  
 Allotype one female, length 15.6 mm, C6033 SAM;

Paratypes 3 males mean length 15.7 mm, range 15.2–16.8 mm, five females mean length 14.9 mm, range 13.5–16.5 mm. C6034 SAM.

#### *Type locality*

A claypan near Warburton Crossing, Clifton Hills Station, northeast South Australia. 27° 02' S, 138° 53' E, coll. B.V. Timms, 5-xii-2000.

#### *Other material*

A cane-grass swamp, Bindegolly Nat. Pk, Qld, 27° 56' S, 144° 13' E, coll. M. Handley, 10-vii-2001, 2 males, 1 female QM W25799

#### *Etymology*

Name alludes to the huge frontal appendage which is impressively lamellar in construction.

#### *Description of male*

First antennae (FIG 8A) slightly longer than proximal segment of second antennae; truncated apex bearing a short seta and a few hair-like setae subterminally. Second antennae (FIG 8A) with proximal segments projecting laterally 50° and fused basally. Proximal segment bearing a distolateral rectangular protuberance about twice as long as broad, and with rounded extremities. Proximal segment with a posterodistal, triangular antennal appendage approximately half the length of the segment length. Antennal appendage lamellar, smooth, but with a series of papillae on the distal margin, less numerous apically. One papilla subterminally on the basal margin. Distal segment of second antennae sclerotized, bent medially 90° at a basal notch on its medial side, explanate in plane of antenna, and terminating in an acute point. Distal segment subequal to proximal segment and only half as wide.

Frontal appendage (FIG 8B) lamellar and about double the size of the second antenna. Trunk short <10 pseudosegments, distal most bearing small lateral digitiform processes. Branches fused into a lamellar sheet with posteriolateral projections on each side. Each projection bearing five long basolateral digitiform processes. Apex of projection extends as a narrow, bifurcate process with lateral papillae. Lamellar sheet with papillae lateroventrally and laterally. Apex of sheet broadly triangular and bifurcated distally. Distomedial projection with well spaced small papillae ventrally. These papillae extend to the central region of frontal appendage.

Rigid basal portion of penes fused and extend two segments (FIG 8C), with a rounded protuberance posteriolaterally. Eversible portion of penes extending to first postgenital segment (FIG 8D). Many short, narrow spines on central and subterminal parts, mostly on convex lateral margin,

A few broad-based spines mostly in a longitudinal dorsal row, more numerous subterminally.

Fifth thoracopod (FIG 8E) with both first and second endites large and evenly convex, first endite about 3 times larger than the second. Endites 3–5 each a small asymmetrical protuberance; submargin of all endites clothed in numerous minute hair-like setae. Anterior setae of endites 1 to 5 in formula 2,1,2,2,1 with a seta on each of endites 1 and 2 with a small subtending spine. Distal seta each on endites 1 and 2 pectinate, and distal seta each on endites 3–5 plumose. Endites 3 and 4 with proximal seta almost bare, and about half the length of the other seta. Posterior setae in formulae >45, *etc* 17–20, 3,2,1–2. Endopodite broad, slightly longer than wide, and fringed with setae. Setae shorter and stouter than setae of endites and exopodite. Three well-spaced setae with bulbous bases on medial margin, many closely spaced setae on distal margin but with bulbous bases smaller. Many shorter setae without expanded bases on the lateral margin. Exopodite long and narrow, about one and a half times the length of the endopodite. Setae of exopodite varying in length, longest distally, but overall shorter than endite setae. Epipodite cylindrical, about three times longer than broad and tapering distally to a truncate apex. Praeepipodite twice as long as broad with distolateral corner almost angular; margin smooth. Thoracopod 1 similar to thoracopod 5 but smaller. Thoracopod 11 also reduced in size and endites lack most of their ordinary setae.

Telson together with cercopods about as long as two abdominal segments and cercopods bearing plumose setae on both margins. Setae uniform in length except for the shorter basal ones.

#### *Description of female*

First antennae (FIG 8F) short, slightly longer than second antenna. Similar setae apically as in males. Second antennae (FIG 8F) short, about 2.5 x longer than wide, apically rounded, but with a small distal acute apex. Many setae surrounding apex.

Brood pouch extending to 3rd postgenital abdominal segment (FIG 8G). Surface of cysts bearing large, regular polygons with raised edges and depressed centres.

Thoracopods and cercopods as in male, except that medial and distomedial setae of endopodite lack bulbous bases.

#### *Comments*

The Bindegolly specimens (FIG 6E & F) are a little different from the type material most notably in the structure of the second antennae and the frontal appendage. In the type material the length and width of the frontal appendage are subequal, but in the Bindegolly specimens the width is almost twice the

length. Lateral papillae are more numerous, there are 6 (instead of 5) larger digitiform processes on the basolateral margin and ventral papillae less numerous in the Bindegolly specimens. Interestingly the lamella is thickened at the basal margin, indicating that this is the position of the frontal appendage branch and that lamella apically of this is an outgrowth. On the second antennae, the lamellar outgrowths on the medial surface of the proximal segment, are more pronounced in the Bindegolly specimens. The outgrowth at the junction of the two segments has fewer papillae, including none on the ventral margin. The distal segment of the second antennae is proportionally wider than the counterpart in the type specimens.

*B. lamellata* is most closely related to *B. budjiti* (Timms, 2001). Their second antennae are very similar, but the medial projection is unique to *B. lamellata* among the Thamnocephalidae. While both species have lamellaform frontal appendages with a few longer digitiform processes on the lateral margin, the general shape of the appendages are different. The two species are easily differentiated however, by the shape of the distal margin – a triangular protrusion forked apically in *B. lamellata*, compared to a concave or angular embayment in *B. budjiti*.

While the lamellar frontal appendage sets *B. lamellata* (and *B. budjiti*) apart, it shares many features with Group II members as defined by Geddes (1981). These include the small to moderate size, short distal endites with 2–4 anterior setae on endites 3–5 of thoracopod I, and swellings lateral to the penes. The alliance is strengthened when it is realised that the frontal appendage does indeed have the structure of a trunk and two branches, though the branches have lamellar outgrowths apically. So *B. lamellata* is an aberrant member of the group, and *B. budjiti* is even more on the fringe of the group (Timms 2001).

In Geddes' (1981) key to Australian species of *Branchinella*, *B. lamellata* keys with difficulty to *B. latzi*. The key needs to be modified with an extra coupler between 6 and 7, which will serve also to key *B. budjiti*:

- 6a Frontal appendage lamellar on a short trunk ..... 6b  
 — Frontal appendage with cylindrical branches and a short or long trunk ..... 7  
 6b Lamella of frontal appendage with a triangular protrusion apically ..... *B. lamellata*  
 — lamella of frontal appendage with a concave or angular embayment distally ..... *B. budjiti*

*B. lamellata* is known from its type locality in northeast SA (FIG 2), and also 525 km to the east, near Thargomindah in southwest Queensland.

### *Branchinella latzi* Geddes

*Branchinella latzi* Geddes, 1981, pp 273–5, fig. 11.

#### Records

Geddes 1981 NT: pool 11 km s Barrow Creek, 21° 35' S, 133° 47' E; Yalgoo-gamie Ck., Mt. Doreen Str., 21° 49' S, 131° 10' E; pool Mt Doreen Str., 22° 02' S, 131° 20' E; Boundary bore, Mt. Allen Str., 22° 23' S, 131° 57' E. AM P19224 to P19226; pool Mt Allen Str., 22° 25' S, 132° 00' E; pool Napperby Str., 22° 45' S, 132° 29' E; Witley waterhole, Todd R., 23° 38' S, 133° 53' E; pool Mt Blatherskite, Alice Springs, 23° 42' S, 133° 43' E; rock pools, Uluru, 25° 21' S, 131° 03' E. *New Material NT*: 10 km N Hatches Ck., 20° 47' S, 135° 12' E, coll. P. Latz and D. Howes, 24-iii-70.

#### Comments

The large majority of *B. latzi* records occur within a 300 km radius of Alice Springs (FIG 3) with one record from southwest Qld (Geddes, 1981), which may approximate its natural distribution, or could result from the collecting activities of Alice Springs based collectors. Interestingly it was once (in 1952) found in rock pools at Uluru, but these pools only have had *B. affinis* in recent years (1979, 1991, 2001) (see comments on *B. affinis*).

### *Branchinella lyrifera* Linder

*Branchinella lyrifera* Linder, 1941, pp 253–5, fig. 34.

#### Records

Geddes 1981 SA: claypan W L. Fyre, 28° 59' S, 136° 26' S; pool in Stuart Ck., 29° 40' S, 137° 07' E. Geddes 1981 NT: dam Brunette Downs Sm., 18° 46' S, 135° 51' E. AM P19236; Upper Amazon Lagoon, Alroy Str., 19° 17' S, 136° 04' E. MAGNT C4871; pool 19 km SE Soudan, 19° 46' S, 135° 56' E; pool 65 km N Alice Springs, 23° 09' S, 133° 43' E. *New Material SA*: roadside pool, Bolivar, 34° 46' S, 138° 35' E, coll. A. Haughey, ii-69; dam S of L. Phibbs on road to Stuart Creek Sm., 29° 35' S, 137° 05' E, coll. W. Zeidler, 13-xii-74, SAM C6047; Birribrana Waterhole, west of Lake Eyre, 28° 13' S, 135° 32' E, coll. J. Pritchard, 2-xi-01; claypan at Nilpinna, 28° 06' S, 135° 45' E, 1-xii-00; pool near Ulthoomurra Waterhole, 27° 08' S, 138° 44' E, 3-xii-00; pool near Pirricooomoo Waterhole, 27° 10' S, 138° 44' E; 4-xii-00; pool near Goyder Lagoon Waterhole, 26° 58' S, 139° 01' E, 6-xii-00; pool at Corkwood Yards, Birdsville Track, 26° 59' S, 138° 21' E, 8-xii-00; pool by Birdsville Track near Bobbiemongie Turnoff, 26° 35' S, 139° 37' E, 9-xii-00; pool east of Pandie Pandie, 26° 11' S, 139° 31' E, 10-xii-00; dam 35 km S Pandie Pandie, 26° 29' S, 139° 31' E, 10-xii-00, all coll. BVT.

### Comments

*B. lyrifera* is widely distributed (FIG 5) but is apparently absent from the far north and far south of the study area, as it is in WA (Timms In Press). It typically occurs in turbid waters, as it does elsewhere in Australia (Timms & Sanders In Press).

### *Branchinella occidentalis* (Dakin)

*Branchinella australiensis* (Richters) var. *occidentalis* Dakin, 1914, pp. 294-5, pl. I, figs. 1-5.

*Branchinella occidentalis* (Dakin). Linder, 1941, pp. 252-3; Geddes, 1981, pp. 260-1, fig. 3.

### Records

Geddes 1981 SA: claypan W of L. Fyre, 28° 50' S, 136° 28' E. New Material SA: Emu Ck, 29° 43' S, 136° 19' E, coll. W. Zeidler, 5-xii-74, SAM C6051; claypan at Nilpinna, 28° 06' S, 135° 45' E, coll. BVT, 1-xii-00.

### Comments

*B. occidentalis* is sparsely distributed in the north of South Australia (FIG 4) and elsewhere across Australia (Geddes 1981), and prefers turbid claypans as it does in the Paroo and in WA (Timms & Sanders In Press, Timms In Press).

### *Branchinella pinnata* Geddes

*Branchinella pinnata* Geddes, 1981, pp. 278-81, fig. 13.

### Records

Geddes 1981 NT: No. 3 dam Warrego Mine, Tennant Creek, 19° 23' S, 133° 53' E; 10 km N Hatches Ck., mine, 20° 48' S, 135° 16' E, AM P19227 to P19229; 7 km S Barrow Ck., 21° 34' S, 133° 49' E; 10 km S Barrow Ck., 21° 35' S, 133° 47' E; 10 km N Ammaroo, 21° 38' S, 135° 15' E. New Material NT: Roper R. Rd., 8.2 km E of Sturt Highway, 14° 59' S, 133° 07' E, coll. M.J. Tyler, 13-ii-83; pool 41 km S Top Springs, 16° 50' S, 131° 32' E, coll. M.J. Tyler, 12-ii-83; Morphett Ck. waterhole, 90 km N of Tennant Creek, 17° 54' S, 134° 05' E, coll. A. Fernie, 13-vi-95, MAGNT Cr12786.

### Comments

*B. pinnata* occurs in the middle Northern Territory (FIG 2) as well as inland Qld and northwestern NSW (Geddes 1981; Timms & Sanders In Press).

### *Branchinella proboscidea* Henry

*Branchinella proboscidea* Henry, 1924, p. 131, pl. 29, figs. 5-9 and pl. 30, figs. 1-3; Linder, 1941, p. 257; Geddes, 1981, p. 269-70, fig. 9.

### Records

Geddes 1981 NT: pool, Napperby Stn., 22° 51' S,

132° 36' E, AM P19234. New Material SA: claypan 400 m N airstrip Olympic Dam, 30° 29' S, 136° 53' E, coll. M.J. Tyler, 11-ii-81; flooded grassland, 18.7 km along track from Andamooka to Olympic Dam, 30° 27' S, 136° 39' E, coll. M.J. Tyler, 12-ii-81; pool near Oodnadatta, 27° 35' S, 135° 27' E, coll. P. Hudson, 3-iv-01.

*B. proboscidea* remains an uncommon species in the NT and now has also been recorded from SA, but only sparsely and from inland areas (FIG 5).

### *Branchinella tyleri* sp. nov.

(FIG 9)

### Type material

Holotype: one male, length 10.3 mm, MAGNT Cr 013175; Allotype: one female, length 10.2 mm, MAGNT Cr 013175; Paratypes: five males mean length 10.0 mm, range 9.3 - 10.6 mm, three females mean length 9.9 mm, range 9.0 - 10.4 mm, MAGNT Cr 013176.

### Type locality

Pool 6-7 km upstream of bridge over Victoria R. on Victoria Highway, NT, 15° 26' S, 131° 12' E, coll. M. J. Tyler, 9-ii-83.

### Other material

Pool 20 km by Delamere Highway S of Victoria/Delamere Highway junction, 15° 28' S, 131° 37' E, 11-ii-83; pool by Delamere Highway 113 km S of Victoria/Delamere Highway junction, 16° 11' S, 131° 59' E, 11-ii-83, MAGNT Cr 013177; pool by Stuart Highway 226 km S of Katherine, 15° 44' S, 133° 25' E, 13-ii-83, all coll. M. J. Tyler.

### Etymology

The name honours Michael Tyler, renowned herpetologist and also collector of many fairy shrimps in remote areas of Australia.

### Description of male

First antennae (FIG 9A) slightly longer than proximal segment of second antennae; apex truncated, bearing four hair-like setae. Second antenna (FIG 9A, B) fused together basally for < 15% of its total length and with proximal and distal segments subequal in length. Proximal segment cylindrical, basomedial surface bears longitudinal patch of small papillae each terminating in a small spine. Papillate region elevated proximally, mound-like with papillae terminating in longer spines. Distal segment sclerotized, stout basally, narrowing abruptly, evenly arcuate for remainder of length. Apex slightly expanded. Weakly developed medial transverse ridges on distal half.

Frontal appendage (FIG 9B) slightly longer than

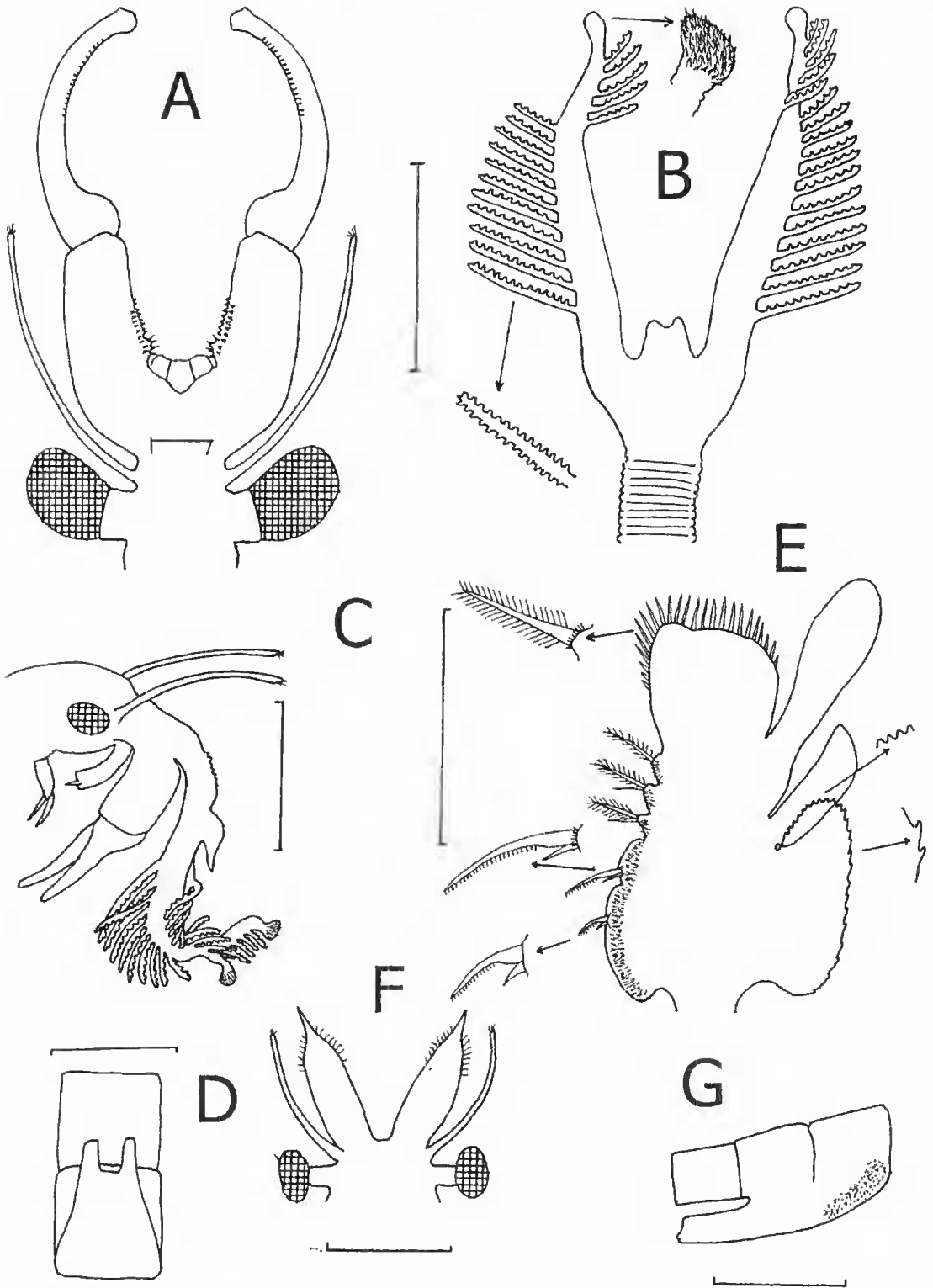


Fig. 9. *Branchinella tyleri* n. sp. A-E male holotype, F-G female allotype. (a) head (b) frontal appendage (c) lateral view of head. (d) rigid portion of penis, (e) fifth thoracopod with posterior seta of all endites and exopodite. (f) head. (g) brood pouch.

second antennae and in preserved specimens tangled into a tight mass (FIG 9C). Trunk short (<20% of total length) divided into unadorned pseudo-segments. Two lateral branches separated by a small lamellar protrusion (flap) bluntly forked (FIG 9 B, C). Each branch of frontal appendage bears about 11 long, thin, digitiform lateral processes, with another 5 processes distomedially. The digitiform processes bear many papillae arranged in opposite pairs on their lateral edges. Branch unadorned medially on basal 2/3rds, and laterally on distal third. Each branch terminates in a knob clothed in sharp spines.

Rigid basal portion of penes (FIG 9D) largely fused and tapering distally, with distal 20% free, cylindrical and extending posteriorly about 1/3 along first postgenital segment. No lateral projections. Structure of eversible portion of penes unknown.

Fifth thoracopod (FIG 9E) with both first and second endite large and evenly convex, the first about 3 times larger than the second. Endites 3-5 each a small asymmetrical protuberance; submargin of all endites clothed in numerous minute hair-like setae. Anterior setae of endites 1 to 5 in formula 2,1,2,2,1 with a seta on each of endites 1 and 2 with a small subtending spine. First pectinate seta and spine with a thick base and spine of second pectinate seta with base fringed with a few thin, short spines. One seta each on endites 1 and 2 pectinate, and one seta each on endites 3-5 plumose. Endites 3 and 4 with second seta almost bare; and about 2/3rds the length of the other seta. Posterior setae in formulae >45, *ca* 17-20, 3,2,1-2. Endopodite quadrate but with a slightly expanded mediodistal corner and a weak depression on the distal surface near the distomedial corner. Setae smaller and stouter than the ordinary setae of endites and exopodite, gradually decreasing in size both medially and laterally, so that the basal sections of endopodite without setae. All setae plumose and surrounded at their base with many short, thin spines. Exopodite elongate oval with setae longest apically and shortest basally. Epipodite subrectangular, three times longer than wide, with apex asymmetrically truncated. Praeepipodite three times longer than broad, arcuate margin with many small serrations distally grading into fewer larger serrations proximally.

Telson with cercopods nearly as long as four abdominal segments and bearing plumose setae on both margins. Setae shortest at base of cercopods and longest about 3/4 along the length of the cercopods.

#### Description of female

First antennae slightly shorter than second antennae (FIG 9F). Similar hair-like setae apically as in male. Second antennae leaf-like (FIG 9F), about three times longer than wide and tapering gradually to a thin apex. Many small spines on outer distal margin.

Thoracopods and cercopods as in male.

Brood pouch (FIG 9G) compact with only a slight expansion of the genital segments and a short neck extending at most to first postgenital segment.

#### Comments

The complexly branched nature of the frontal appendage and the lack of lateral projections to the rigid base of the penes suggest *B. tyleri* is allied to Geddes' (1981) Group III species. Of these it bears greatest resemblance to *B. dubia*, *B. wellardi* and *B. pinnata* because the digitiform processes of the frontal appendage are not further ramified. None of these species has the lateral and medial arrangement of digitiform processes as in *B. tyleri*. *B. wellardi* shares two notable features with *B. tyleri* - the paired papillae on the digitiform processes and the lamellar outgrowth at the distal junction of the two lateral branches. However *B. wellardi* has digitiform processes on both margins of the lateral branch and lacks the terminal spine-covered expansion of the lateral branch seen in *B. tyleri*. These terminal spines have a simple analogue in the single strong terminal spine on each lateral branch in *B. dubia*, but there is no expansion of the apex as in *B. tyleri*, nor the large number of lateral digitiform processes and the medial digitiform processes as in *B. tyleri*.

In Geddes' (1981) key to Australian species of *Branchinella*, *B. tyleri* keys to *B. wellardi*, so an extra couplet at couplet 15 is needed to separate these two species:

- 15a. Lateral branch of frontal appendage terminating in a spine-covered knob; digitiform processes of lateral branch at any one section on one margin of only ..... *B. tyleri*  
 Lateral branch of frontal appendage terminating in the same digitiform processes that line both margins of the branch ..... *B. wellardi*

*B. tyleri* occurs only in the Victoria River district and adjacent area to the east in the Northern Territory (FIG 4).

#### Discussion

The relationships of the new species to other members of *Branchinella* is apparently clearer than for other species recently described (Timms 2001, *In Press*), with *B. insularis* easily accommodated into group II, *B. tyleri* into group III, and *B. lamellana* is near group II. While there are difficulties with some species, the vast majority of species show relationships to one of three groups as initially proposed by Geddes (1981), elaborated by Timms (2001, *In Press*) and added to here. However in an analysis of relationships using DNA technology



(Remigio et al., in press), only Group III is a robust grouping, so the relationships of these species, except perhaps *B. tyleri*, is unknown.

This study has increased the species of *Branchinella* known from South Australia from three to nine and in the Northern Territory from six to nine. Five species occur in both, so that overall 13 species are known from both areas. Three of the species are new, but only one endemic species is known from each area, *B. insularis* for the south of SA and *B. tyleri* from the north of the NT. Considering the large combined area (2,330,000 km<sup>2</sup>) of the two jurisdictions and the broad latitudinal spread, this is not a large number (cf 18 species in WA - Timms In Press). Moreover only 11% of species are endemic in each jurisdiction and 15% overall, compared to 50% in WA (Timms In Press). The two study areas are of similar size, so area cannot be affecting species richness, but lack of isolation and lower habitat variety may be. SA & NT share many biogeographic areas with the eastern states, while large areas of WA are biogeographically distinct. An example is the sharing of four arid-zone anostracans (*B. arborea*, *B. budjiti*, *B. lamellata*, and *B. latzi*) between central SA, central NT, sw Qld and nw NSW. This relative lack of isolation is expressed in the low endemism in SA and the NT. Perhaps also there is not the habitat specialization as there is in WA and especially in the Paroo, where there are 14 species of *Branchinella* in a 2,000 km<sup>2</sup> area in many types of waters (Timms & Sanders In Press). As an example, the specialized habitat of gnammas on rock outcrops does not seem to have a specialized species in SA or the NT. In WA these are occupied by the endemic *B. longirostris* in the wheatbelt and adjacent areas and by another endemic *B. basispina* in the western Nullarbor (Timms In Press). By contrast, the gnammas of Eyre Peninsula in SA seem to lack fairy shrimps (I.A.L. Bayly, pers. com.; BVT, unpublished data), while rock holes in the southern NT are inhabited by widespread species such as *B. affinis*, *B. latzi* (see above) and *Streptocephalus* sp. (Bayly 2001).

As for much of Australia, including WA, the most common and widespread species are *B. affinis* and *B.*

*australiensis* (Geddes 1981; Timms In Press). Other widespread but less common species include *B. tyriifera*, *B. occidentalis*, and *B. proboscidea*. Of the remaining species, two (*B. dubia* and *B. pinnata*) are shared across tropical Australia, four (*B. arborea*, *B. budjiti*, *B. latzi*, *B. lamellata*) seem to be arid-zone specialists, while two of the new species have localised distributions, *B. tyleri* in the Victoria R district of the NT and the other, *B. insularis*, on Kangaroo Island.

It is difficult to assess the true distribution and relative abundance of fairy shrimps in the study area, as many remote areas have still not been visited at the appropriate time, e.g. northwest of SA, southeastern NT. Furthermore some species like the large *B. australiensis* are probably proportionally overrepresented in the collections, because they are more easily seen by a curious public. At least another two undescribed species seem to exist, one from an unknown site in the Northern Territory for which MG holds two subadult males, and another from Lake Torrens for which the material seems to have been lost. The later could be most interesting as it is relatively large (P. Hudson, pers. com.) and lives in the hyposaline waters of an episodic lake (Williams et al. 1998), and so could be a localised member of the *B. nichollsi* group of species. The chances of collecting it again are low as Lake Torrens rarely fills (Williams et al. 1998). This factor combined with remoteness of many parts of the study area means it is difficult to collect fairy shrimps adequately. Nevertheless this study has greatly improved knowledge of *Branchinella* in South Australia and the Northern Territory.

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